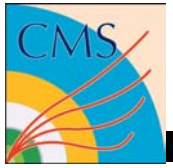
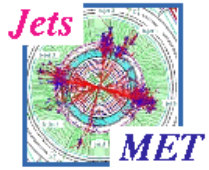


Low-lumi SUSY and Some Other Issues Revisited



S. Abdullin

Outline

- Low-mass low-lumi SUSY revisited (with S.Kunori)
  - Reminder
  - New (broader) bandwidth allocation
  - Quick cuts evaluation (without thorough optimization)
- Re-estimate of HCAL occupancy
  - New (short) shape
  - Full simulation without BCID
- One more look at $\Delta\phi$(Jet1,Jet2) cut

SUSY Trigger : Reminder (I)

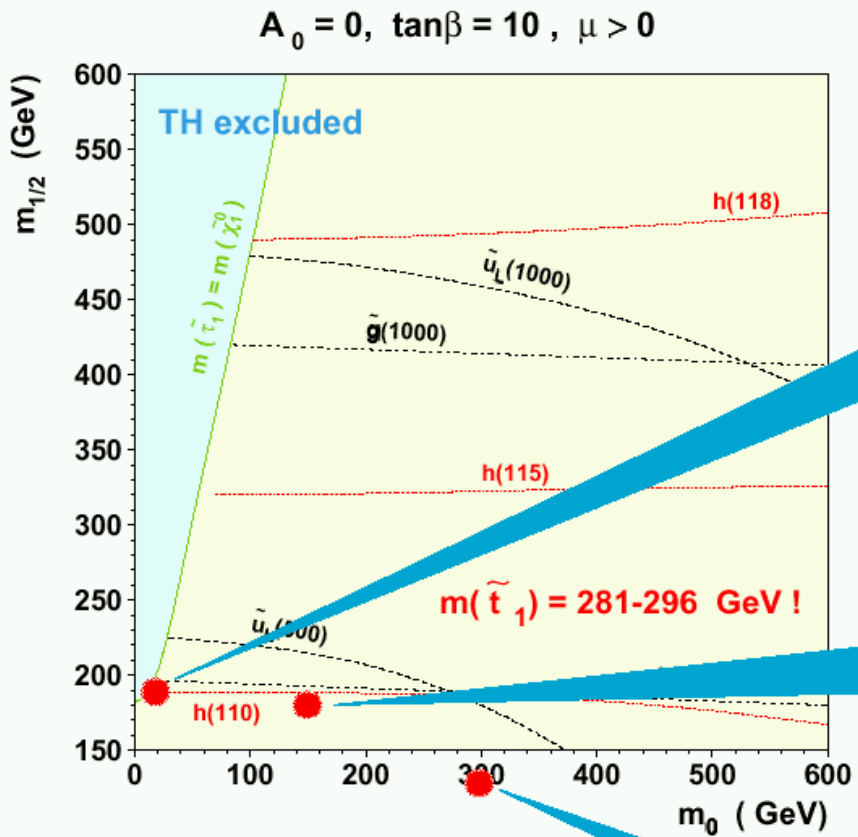
- Low luminosity study : CMS IN-2002/036

  http://cmsdoc.cern.ch/~abdullin/events/talks/acat2002.pdf

  - Probing points studied at the Tevatron II reach limit
    (along squark isomass curve of $\approx$ 400 GeV)
  - Given 2 kHz @ L1 and 3Hz @ L2
  - Hybrid genetic algorithm written for cuts optimization
  - 6 essential combinations of L1 and L2 channels (out of 18)
  - R-parity violation scenario yields marginal efficiency @ L2

SUSY Trigger : Reminder (II)

H.Baer et al., hep-ph/9802441; Phys.Rev.D58:075008, 1998



$m(\tilde{\chi}_1^0) = 70$ GeV $m(h) = 110$ GeV
$m(\tilde{g}) = 466$ GeV $m(\tilde{u}_L) = 410$ GeV
$\sigma \sim 181$ pb tau-enriched,
4 20,190 quite enough sleptons

$m(\tilde{\chi}_1^0) = 66$ GeV $m(h) = 110$ GeV
$m(\tilde{g}) = 447$ GeV $m(\tilde{u}_L) = 415$ GeV
$\sigma \sim 213$ pb nothing special
5 150,180

$m(\tilde{\chi}_1^0) = 45$ GeV $m(h) = 106$ GeV
$m(\tilde{g}) = 349$ GeV $m(\tilde{u}_L) = 406$ GeV
$\sigma \sim 500$ pb $\tilde{q} \rightarrow \tilde{g} + X$, $\tilde{g} \rightarrow$ 3 body,
6 300,130 more jets, less MET

Require $\int Ldt < 10\ pb^{-1}$

SUSY Trigger : Reminder (III)

- R-parity violation as a most challenging trigger scenario (?)
  - $\tilde{\chi}_1^0 \rightarrow$ 3 quarks
  - 6 additional soft jets :
    $\tilde{\chi}_1^0$ mass $\approx$ 45-70 GeV
  - Missing ET shrinks, still some amount remains
    - copious b-jets, W/Z, taus and neutralinos

- **ISAJET 7.58 – ISAWIG 1.104 – HERWIG 6.301**

Points **4R** **5R** **6R**

SUSY Trigger : Reminder (IV)

- 6 mSUGRA samples
  - spring 2002 production
  - 2000 events each
  - low-lumi energy corrections from Andrei Krokhotine
- 3 SM backgrounds ("Bkgd")
  - spring 2002 production
    - QCD (with HF filter) $\approx$ 1,050,000 events
  - autumn 2001 production
    - Wj ($W \rightarrow l\,\nu$) $\approx$ 150,000 ev.
    - $t\,\bar{t}$ $\approx$ 46,000 ev.
  - negligible @L1, still some contribution @L2

SUSY Trigger Revisited (I)

- Previous ("optimized") cuts were considered a bit too complicated (8 L1 && L2 streams) and the bandwidth allocation a bit obsolete …
- So the initial idea was to make L&&L2 streams simpler (more transparent) and to use somehow optimized Njet cut for R-parity violation scenario …
  - taking into account a strong time deficit genetic optimization was given up (at least for a while)

SUSY Trigger Revisited (II)

- @L1 we start with the cuts from Andrei's jets rates :
  - J1(138), J3(66), J4(53) assumed to provide 1 kHz each
  - J1(60)&&MET(65) added for completeness (e.g. inv.Higgs)
- @L2 – basically the same cuts (a bit sharpened) :
  - J1(150), J3(75), J4(60) and MET on top of it
- L1 cuts yield (much) lower rate than anticipated
  - after quite time-consuming investigation some problems were found in Andrei's code ("post factum")

SUSY Trigger Revisited (III)

first iteration …

L1

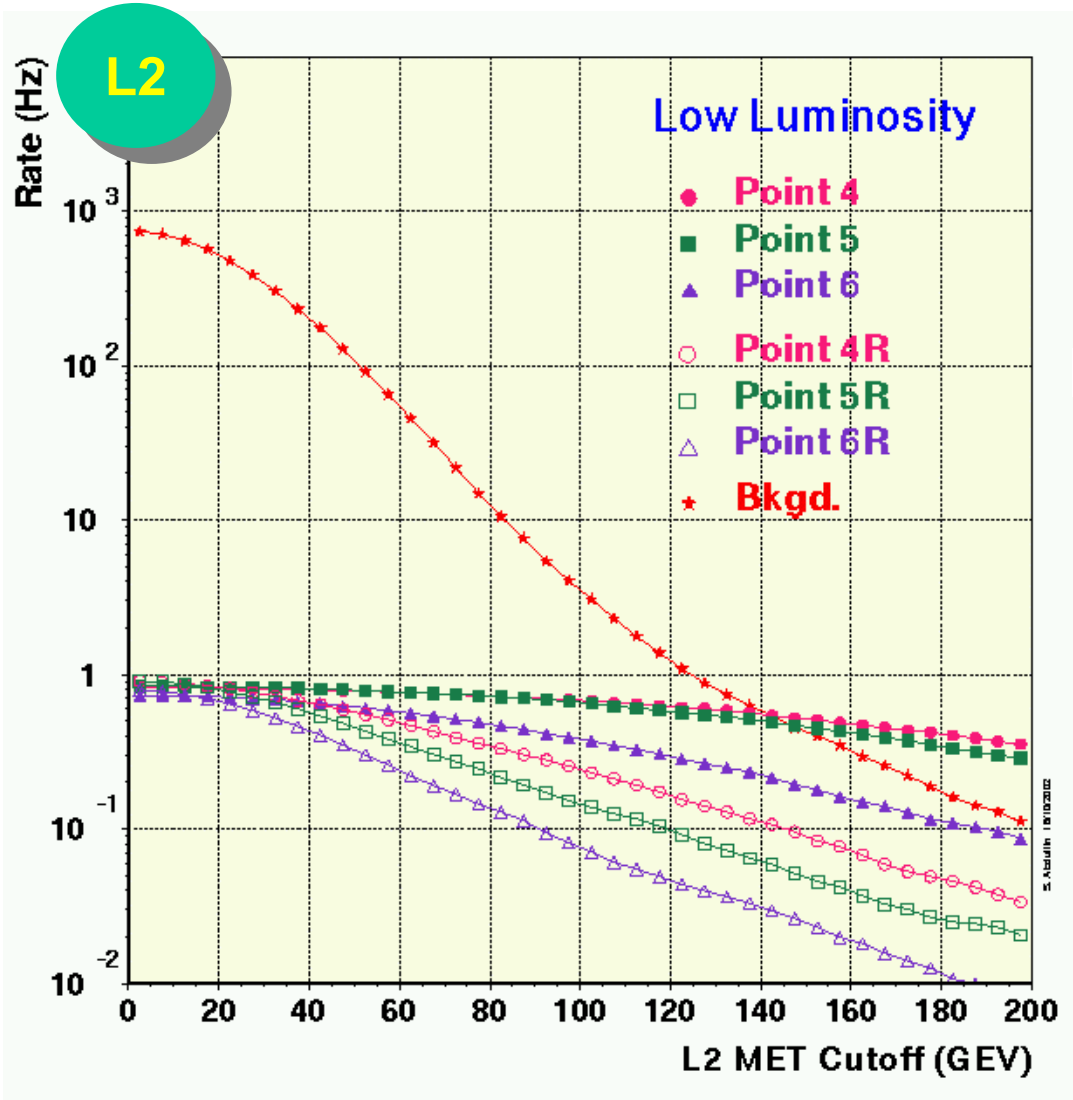
Signal efficiency (%)

	J1 138	J3 66	J4 53	J1&&MET 60 65
4	82 (82)	86 (53)	87 (36)	92 (81)
5	84 (84)	88 (58)	89 (40)	91 (80)
6	70 (70)	79 (61)	80 (48)	83 (58)
4R	90 (90)	93 (85)	94 (75)	94 (50)
5R	89 (89)	94 (86)	95 (76)	95 (39)
6R	67 (76)	86 (79)	87 (70)	87 (27)
Bkgd. (kHz)	0.91 (0.91)	1.20 (0.46)	1.29 (0.20)	**1.61**(0.40)

looks redundant …

SUSY Trigger Revisited (IV)

first iteration …

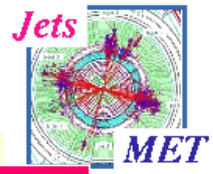


- J1(150) || J3(70) || J4(60)
- MET > 93 GeV : ~5 Hz

4	69 %
5	68 %
6	40 %
4R	26 %
5R	16 %
6R	9 %

not much

SUSY Trigger Revisited (V)



second iteration …

- L1 and L2 (new bandwidthes = 4 kHz and ~15 Hz) seems to be rather decoupled …
  - so we probably don't need too much at L1 to efficiently trigger on SUSY at L2 ?
  - a simplified L1 selection : J3(70) || J1(60)&&MET(65) yields quite a low L1 rate of 0.71 kHz …
  - L2 bandwidth to divide into ~5 Hz for J1&&MET and ~ 7 Hz for #jet cut (for R-parity violation case)
  - 1 Hz for J1 and J3 each (570 and 210 GeV respectively) in addition, so that total L2 bandwidth is about ~15 Hz, not counting b/τ-channels…

SUSY Trigger Revisited (VI)

second iteration …

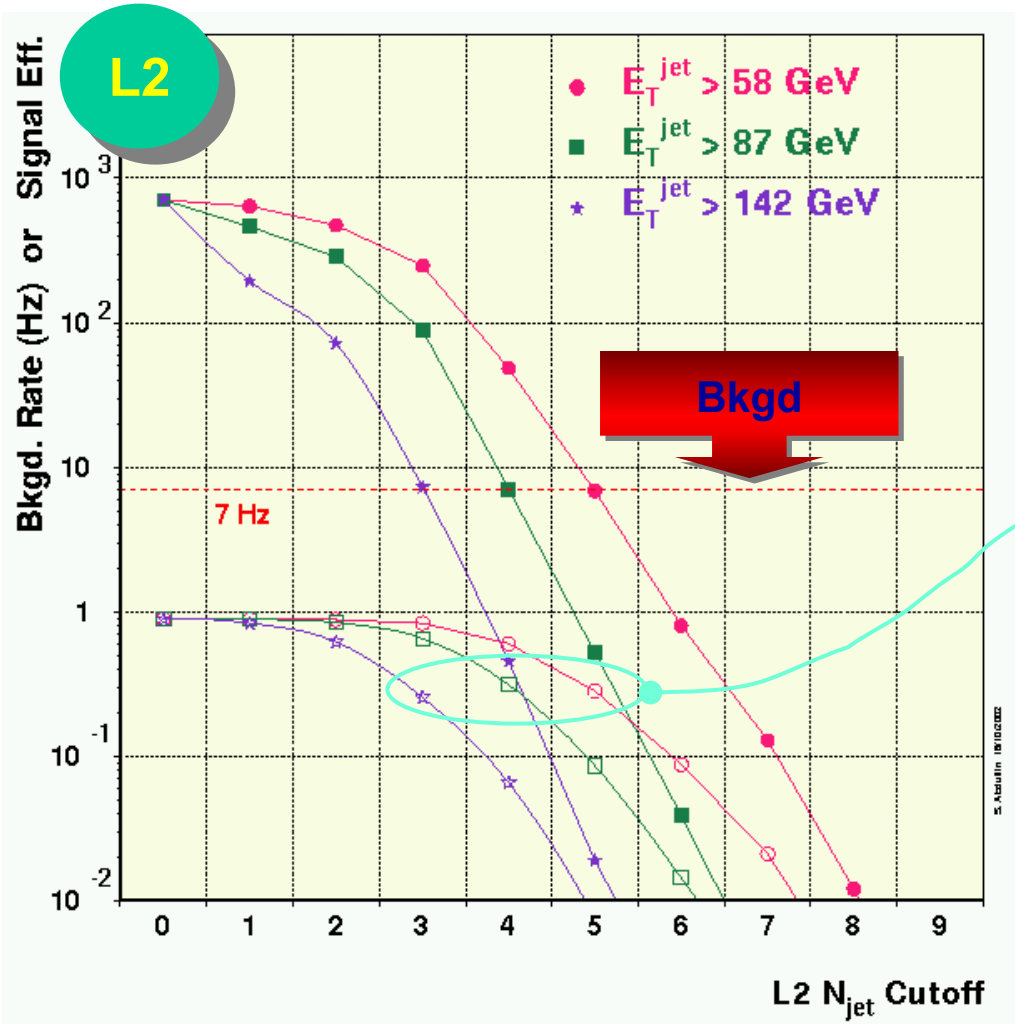
insignificant drop by a few %
still quite sufficient figures …

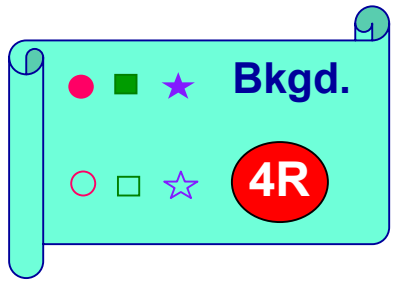
less by a factor of ~ 2.3

SUSY Trigger Revisited (VII)

second iteration …

- What about Njet cut at L2 ?





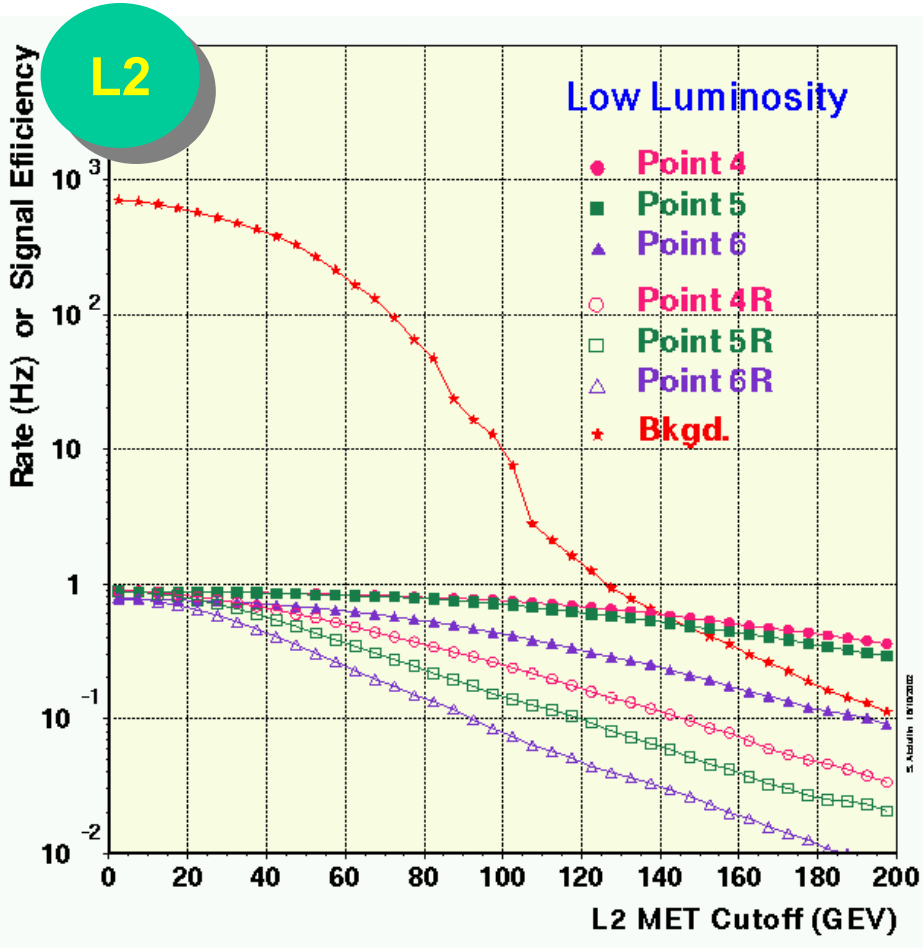
Nj(87)>4 Nj(58)>5

Signal eff.(%)		
4R	31.3	29.3
5R	32.1	28.7
6R	22.5	25.6

SUSY Trigger Revisited (VIII)

second iteration …

- J1 and MET for R-parity conservation scenario



- J1(150) && MET(93) – quite an arbitrary choice…

	J1&&MET 150 93
4	66
5	65
6	36
4R	26
5R	16
6R	9
Bkgd. (Hz)	4.52

Signal efficiency (%)

SUSY Trigger Revisited (IX)

second iteration …

L2

	J4 70	J1&&MET 150 93	Signal rate (Hz)
4	12	68 (66)	0.25
5	15	68 (64)	0.29
6	17	44 (36)	0.44
4R	31	48 (26)	0.17
5R	32	42 (16)	0.18
6R	23	28 (9)	0.28
Bkgd. (Hz)	7.06	**11.37**(4.52)	

Signal efficiency (%)

SUSY Trigger Revisited (X)

second iteration …

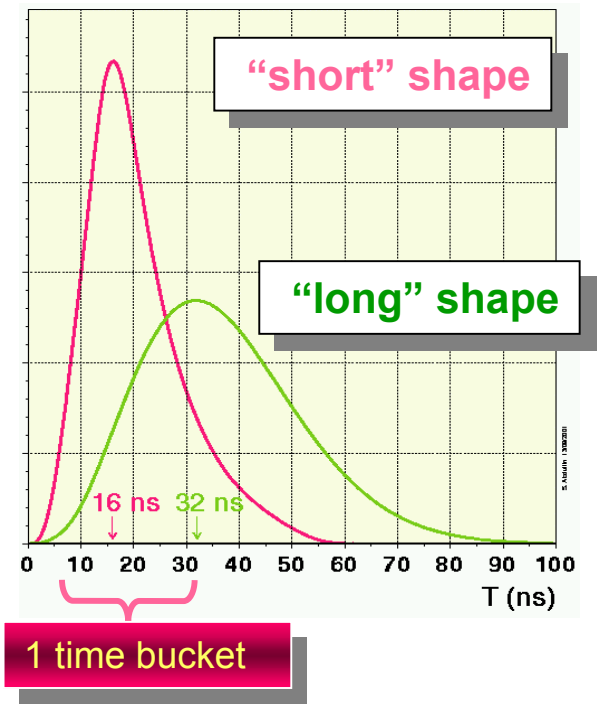
- Extended L2 table including J1 and J3

L2

	J1 570	J3 210	J4 70	J1&&MET 150 93	Signal rate (Hz)
Signal efficiency (%) 4	2	5 (3)	14 (12)	69 (66)	0.25
5	2	5 (5)	18 (15)	69 (64)	0.29
6	1	3 (2)	18 (17)	45 (36)	0.45
4R	1	9 (7)	34 (32)	50 (26)	0.18
5R	2	8 (7)	35 (32)	44 (16)	0.19
6R	1	4 (3)	23 (23)	29 (9)	0.29
Bkgd. (Hz)	0.81	1.51(0.89)	8.15(7.06)	12.29(4.52)	

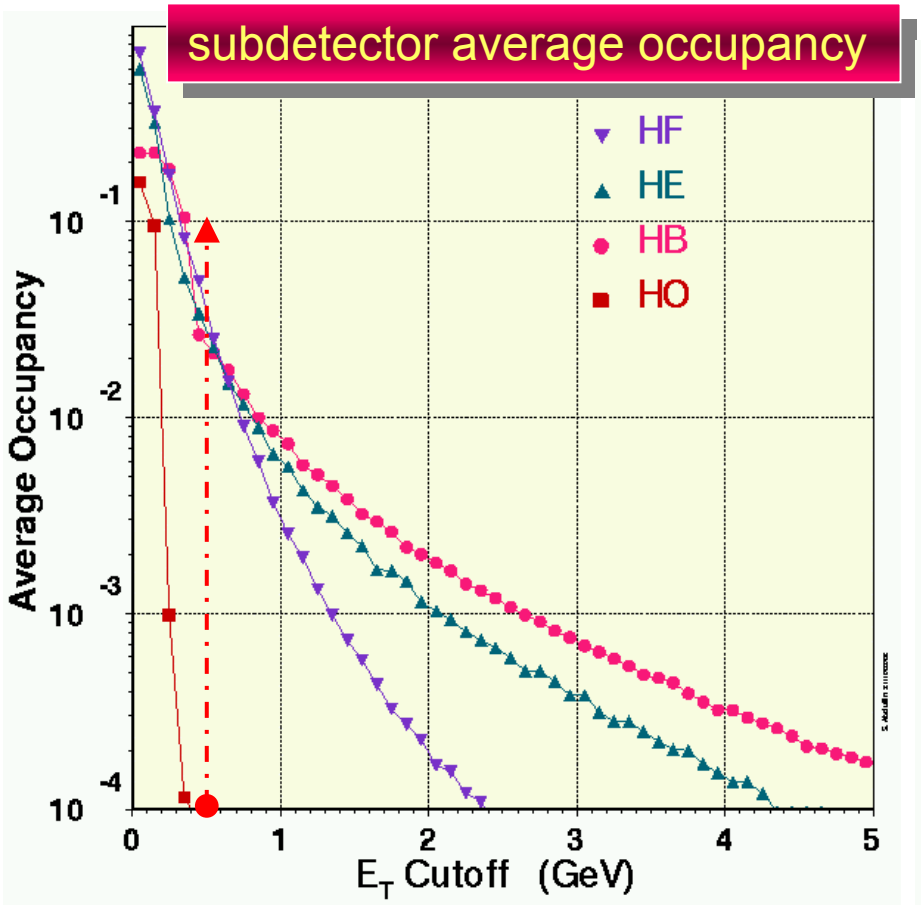
HCAL Occupancy Revisited (I)

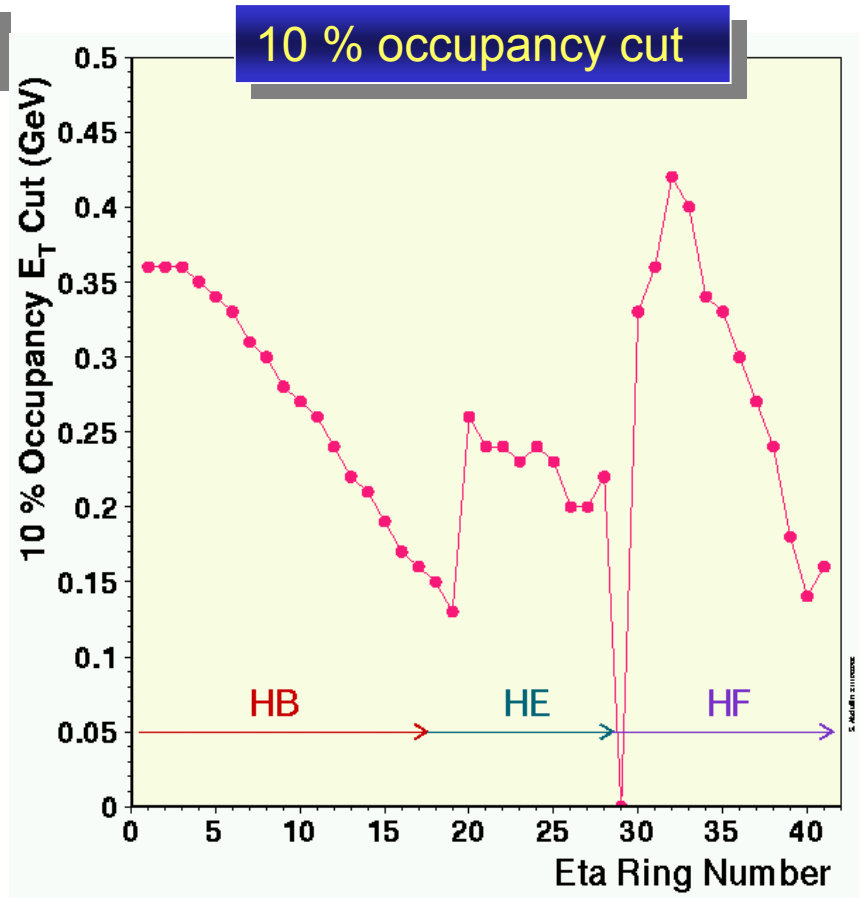
- Summer test beam provided evidence in favor of the “short shape”
  - ~ 80 % collected in 1 time bucket
  - noise is smaller (than collected in 2 buckets with “long shape”)
- Calculations in CMS IN/2001-037 are not really suitable (for DAQ TDR)
  - long shape
  - Rather L1 estimates, as BCID was on
  - toy MC calculations for a few η rings



HCAL Occupancy Revisited (II)

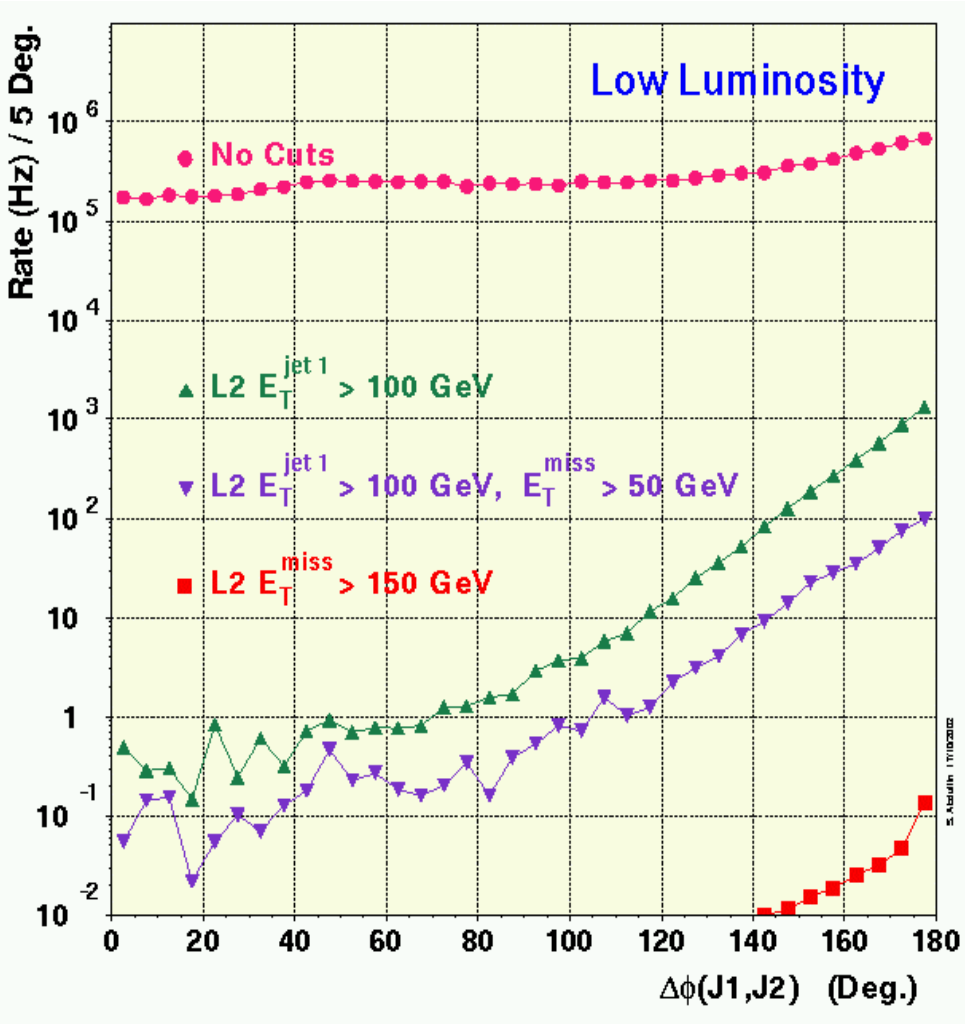
- $\Delta\phi \times \Delta\eta$ size of towers differ, so we normalize Et
  - by the size of HB tower (0.087 x 0.08726)





$\Delta\phi$(J1,J2) Revisited (I)

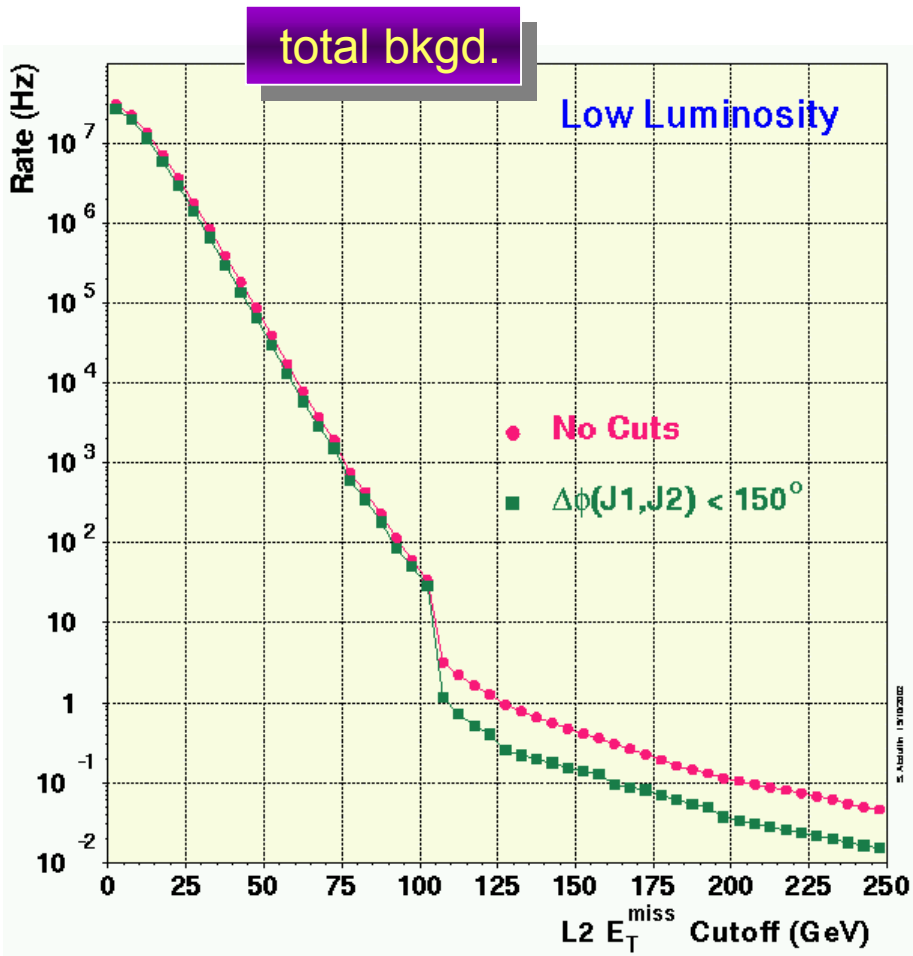
- Though to be a QCD "killer" once upon a time …

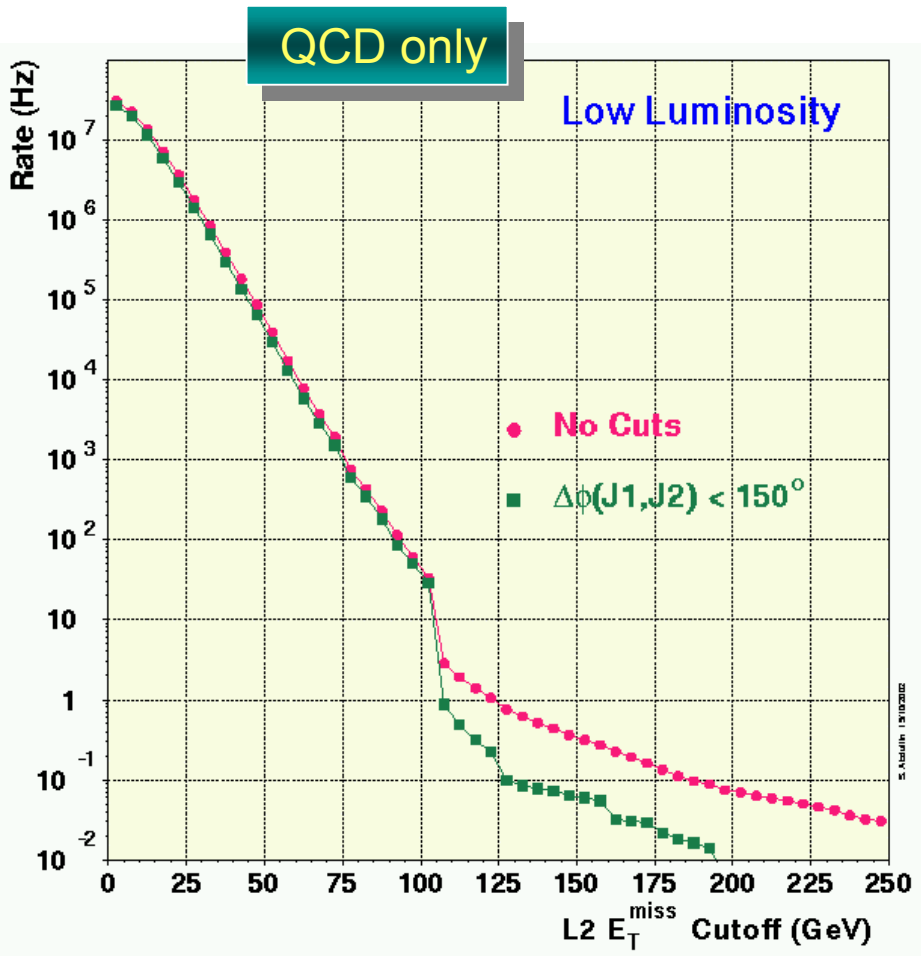


- only a very high MET provides noticeable peak at $\Delta\phi \sim \pi$
- better to rely on J1 …

$\Delta\phi$(J1,J2) Revisited (II)

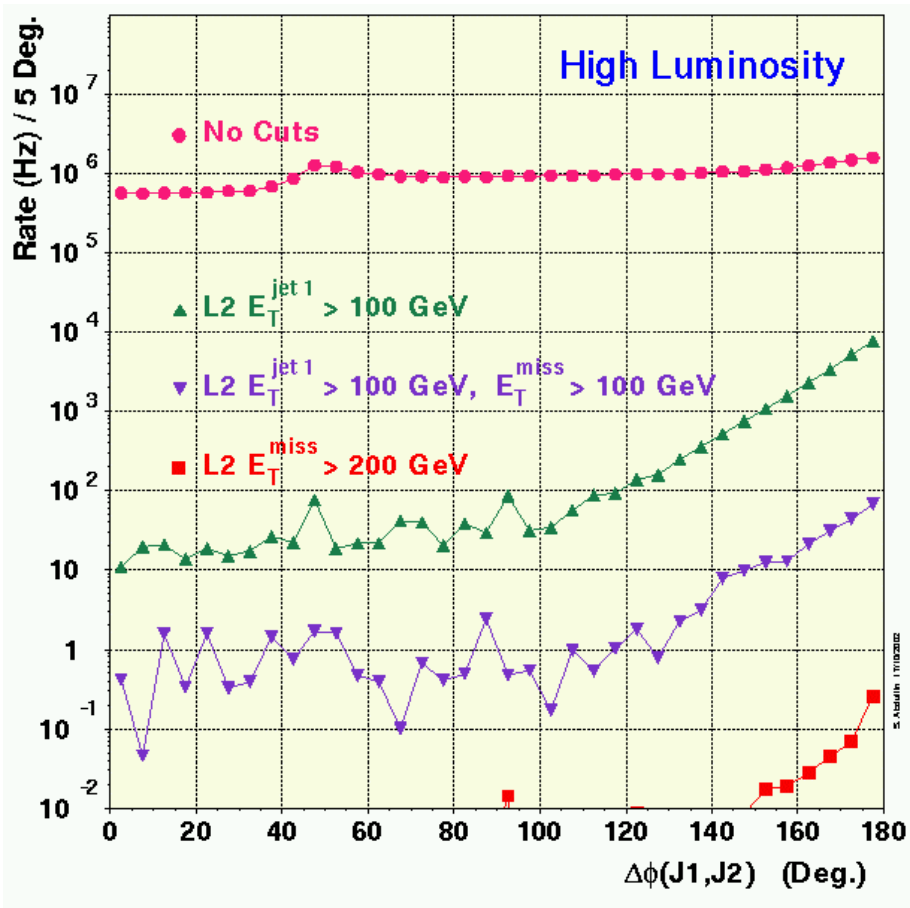
- Modest $\Delta\phi$(J1,J2) cut does not look very impressive

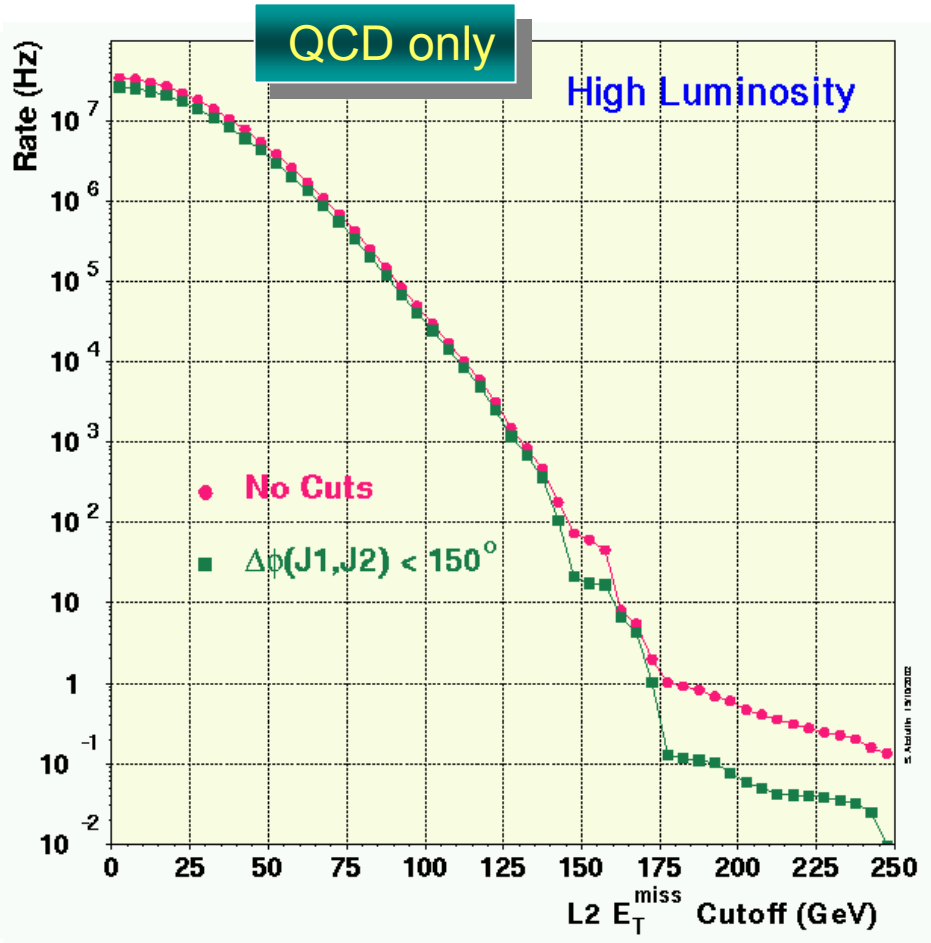




Δφ(J1,J2) Revisited (III)

- similar to low-lumi case, less peaking (spoiled) though





SUMMARY

- Low-mass SUSY trigger revisited
  - Both with/without R-parity violation
  - Cuts are somehow optimised for given bandwidthes
  - A few simple cuts do the job
  - Efficiency is probably high enough even for ~~R~~-parity
- HCAL occupancy re-calculated with "short" signal
  - Normalized to HB tower
  - Averaged over sub-detectors
  - Doesn't exceed 10% for Et>0.5 GeV per unit
- $\Delta\phi$(J1,J2) looked at once more
  - Might be usefull at L2 in some cases